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HYDROGEN PRODUCTION FROM BIOMASS BY PYROLYSIS AND CATALYTIC STEAM REFORMING

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New technologies for rapid pyrolysis of biomass provide compact and efficient systems to convert biomass into vapors or condensed oils composed of aldehydes, alcohols, acids, and oligomers from the constitutive carbohydrates and lignin. Hydrogen can be produced by catalytic steam reforming of the pyrolysis vapors or the "biocrude" oils. By using a renewable resource feedstock, this process offers an alternative to conventional means of hydrogen production from petroleum and natural gas and provides the benefit of zero net carbon dioxide emissions.

We will present an overview of the distinct project areas: literature review on the composition of pyrolysis oils and the technology of catalytic steam reforming, thermodynamic modeling, experimental catalyst research and development, process development and economic evaluation. Thermodynamic modeling of the major constituents of the biocrude has shown that reforming is possible within a wide range of steam-to-carbon ratios. Experimental studies are being carried out on catalytic steam reforming reactions of model oxygen-containing compounds using shift conversion catalysts and Ni-based catalysts. A plug-flow microreactor coupled to a molecular beam mass spectrometer is used to study reaction mechanisms, screen catalysts and optimize reaction conditions. A bench scale reformer is being built to examine catalyst lifetimes, coke formation and process operations with model compounds as well as actual pyrolysis oils. An initial process diagram for the pyrolysis and reforming operations will be presented, along with initial production cost estimates.

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